

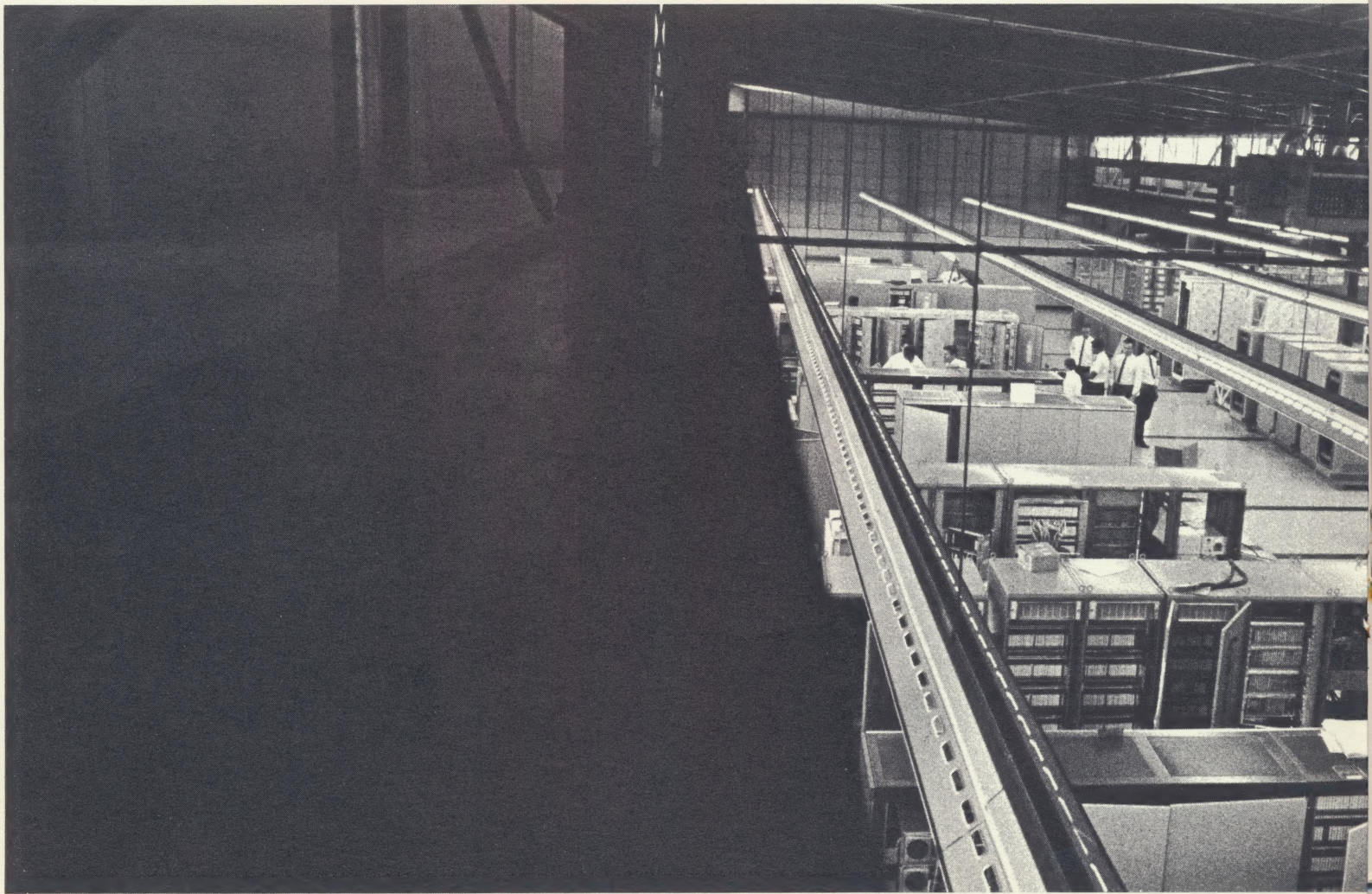


SCIENTIFIC DATA SYSTEMS



SDS General-Purpose Digital Computers

202



SDS General-Purpose Digital Computers

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SDS COMPUTERS

Scientific Data Systems offers a family of six general-purpose digital computers, ranging from the SDS 92—the first commercial computer using monolithic integrated circuitry—to the SDS 910, 920, 925, 930, and 9300. These six computers, designed for scientific and industrial applications, provide more answers-per-dollar with greater reliability than any other computers on the market.

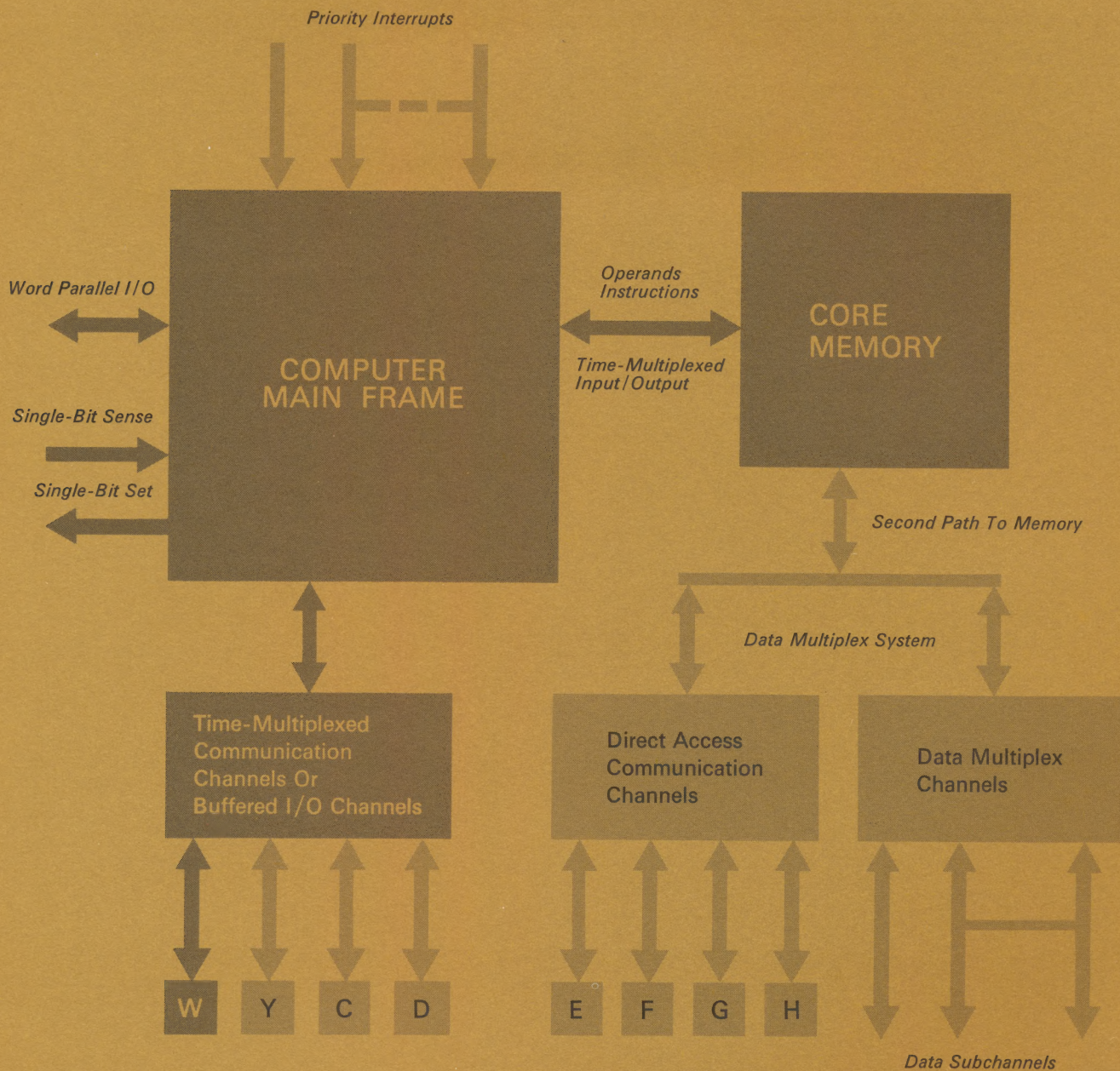
SDS computers are available in a variety of configurations that include card readers and punches, magnetic tape units (conventional and cartridge-loaded types), magnetic drums and discs, display scopes, light pens, and character and vector generators.



For special system requirements, SDS offers a comprehensive line of analog/digital conversion equipment and digital logic modules. A staff of experienced systems engineers has the knowledge required to integrate these products and special hardware into total computing systems.

The comprehensive software package furnished with all SDS computers includes both scientific and business-oriented languages. Supervisory control systems permit automatic scheduling and control with a minimum of operator attention when processing large volumes of programs. SDS programming systems conform to industry-accepted standards so that SDS computers can easily exchange data with and use programs written for other machines.

Design Features □ Rugged mechanical design standards, worst-case electronic design techniques, and high noise tolerance insure trouble-free operation of SDS



Indicates Optional Feature

SDS COMPUTER ORGANIZATION

computers, even under adverse operating conditions. Exclusive use of silicon semiconductors and low component counts give these computers a Mean Time Between Failure at least three times longer than any comparable equipment. Extensive use of integrated circuits in the SDS 92 further improves reliability and lowers operating costs.

Basic Input/Output Channels □ The SDS 910 and SDS 920 have a standard, six-bit plus parity character-oriented, buffered input/output channel that is time-multiplexed with computation. An optional Memory Interlace permits direct I/O communication with core memory without program intervention. A second, optional buffered I/O channel transmits six-, 12-, or 24-bit characters.

The SDS 92 has a standard, buffered I/O channel that transmits six-bit characters, packed one or two per word, and 12-bit characters, one per word.

The SDS 925, 930, and 9300 have a standard six-bit Time-Multiplexed Communication Channel (TMCC) that resembles the standard 910 or 920 buffered I/O channel. Three additional TMCCs can be added to transmit six-, 12-, or 24-bit characters. Memory Interlace is standard with all TMCCs.

Instruction Sets □ A powerful and extensive instruction repertoire is available with each SDS computer. Instruction features common to all machines include: direct and multilevel indirect addressing, with indexing at any level (indexing adds no additional execution time); a completely general shift capability; single and multiple precision arithmetic; all three logical operators (AND, OR, and Exclusive OR); large complement of Branch instructions for decision making; and a complete set of Input/Output instructions.

An SDS innovation, Programmed Operators, available with all SDS 900 Series computers, permits the automatic handling of up to 64 variable subroutines as if they were single, built-in instructions. These instructions are written exactly like machine instructions and can be modified by indexing and indirect addressing.

Input/Output □ SDS computers have unusually fast and flexible input/output capabilities that offer the user a wide choice of operating modes and permit integrating the computers into real-time systems with a minimum of special hardware and programming.

Direct Access Communication Channels □ Up to four optional Direct Access Communication Channels (DACC) can be attached to the SDS 925, 930, and 9300. These channels transmit data in the form of six-, eight-, 12-, or 24-bit characters to and from memory over a path separate from that used by the central processor and TMCCs.

Data Multiplexing System □ A Data Multiplexing System (DMS) that uses a second path to memory is available with the SDS 92, 925, 930, and 9300. The DMS permits connecting an unlimited number of Data Multiplex Channels, each of which can operate with an unlimited number of Data Subchannels. Priorities can be assigned to each Data Multiplex Channel and Data Subchannel.

I/O Operation □ The following types of I/O operation available with all SDS computers, take place simultaneously with I/O transmission over standard I/O channels:

■ **Word Parallel Input/Output (Standard)**

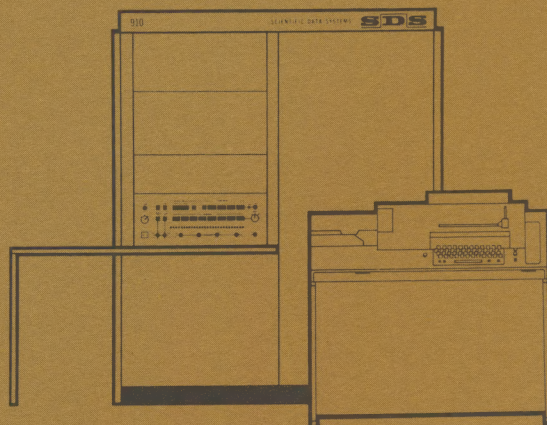
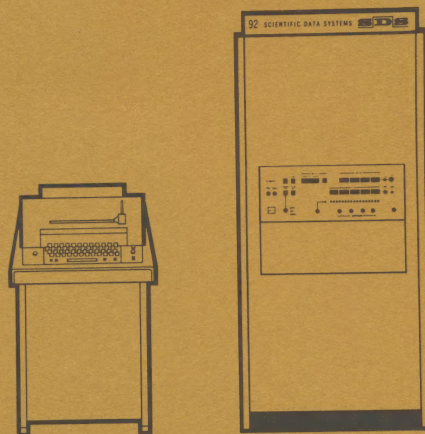
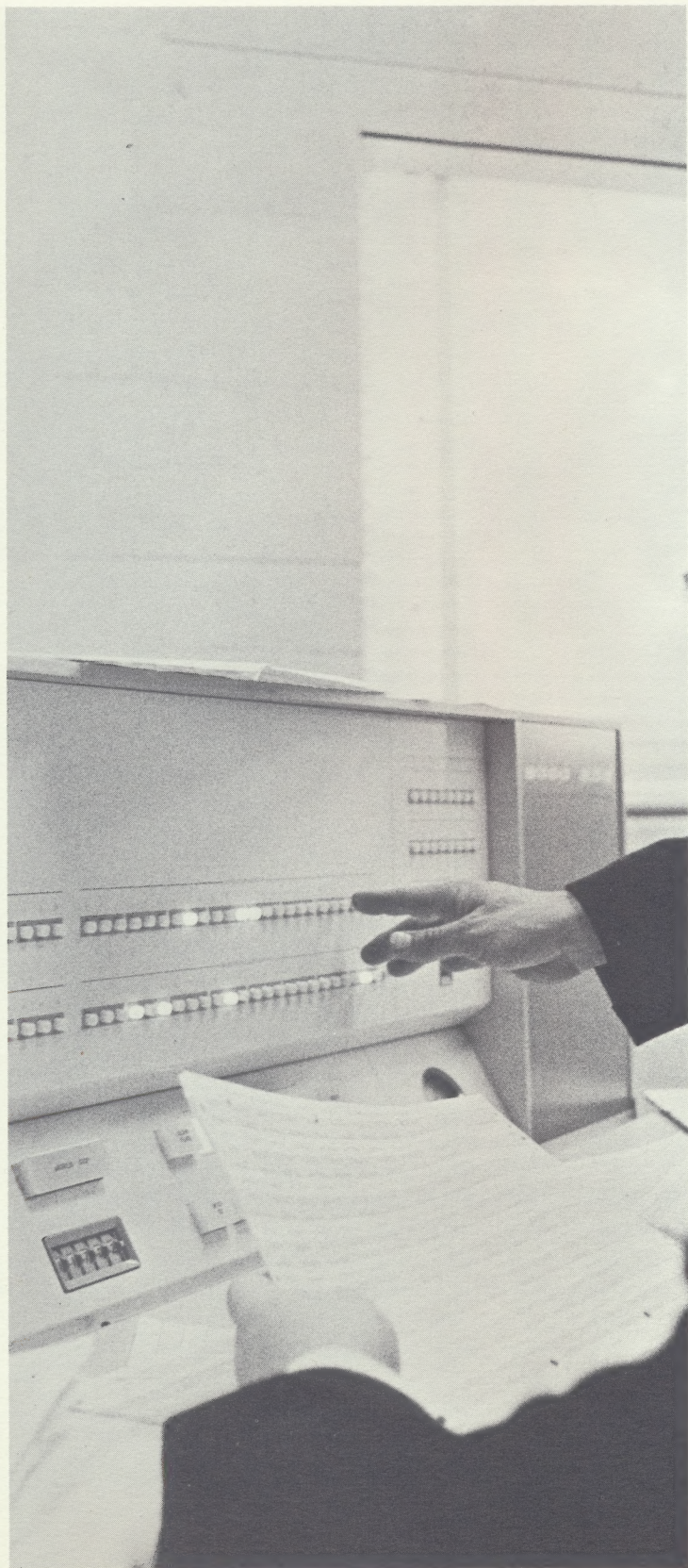
Transfers information from 24 input lines (12 on the SDS 92) into a specified memory location, or vice versa, without disturbing any operating registers. Data can be transferred as single words or large blocks of information, and instructions can be modified by indexing and/or indirect addressing.

■ **Single-Bit Sense and Control (Standard)**

Transmits single-bit, on-off control or test signals to or from external devices or functions within the computer such as Interrupt Enable. Up to 16,384 control signals can be sent and 16,384 input signals tested (4096 in each case on the SDS 92).

■ **Priority Interrupt (Optional)**

Up to 1024 (256 on the SDS 92) channels of priority interrupt are available with SDS computers. Each channel has a unique priority and address in memory and can be selectively armed or disarmed under program control. The computer always processes the highest active interrupt, regardless of its chronological occurrence, interrupting one of lower priority if necessary, and returns to the main program only when all active interrupts have been processed. This interrupt capability lets the computer control, or be controlled by, an external, real-time environment.



computers, even under adverse operating conditions. Exclusive use of silicon semiconductors and low component counts give these computers a Mean Time Between Failure at least three times longer than any comparable equipment. Extensive use of integrated circuits in the SDS 92 further improves reliability and lowers operating costs.

Basic Input/Output Channels — The SDS 90 and 920 have a standard, six-bit plus parity, character-oriented, buffered input/output channel that is time-multiplexed with computation. An optional memory interface permits direct I/O between the computer memory without program intervention. The 920 has an optional buffered I/O channel that can handle 24-bit characters.

The SDS 92 has a standard 10-Terminal Bus which can transmit six-bit characters, 12-bit characters, 24-bit words, and 12-bit characters, one per bus.

The SDS 925, 930, and 935 have a standard 10-Terminal Bus that resembles the standard SDS 920 bus. The 935 has a channel. Three additional 10-Terminal Buses can be added to transmit six-, 12-, or 24-bit characters. The interface is standard with all TACs.

Instruction Sets — A powerful and complete instruction repertoire is available with each TAC. The instruction features common to all SDS computers include: single and multilevel indirect addressing; multiword instructions; level (indexing adds no address); stack operations; a completely general shift capability; floating point and precision arithmetic; all basic logical operations (AND, OR, and Exclusive OR); logical shift left and right; branch instructions for decision making; and input/output instructions.

An SDS innovation, **Programmed Indexing**, is available with all SDS 900 Series computers. It permits automatic handling of up to 64 words of data as if they were single, built-in instructions. These instructions are written exactly like machine instructions and can be modified by indexing and mask instructions.

Input/Output — SDS computers have a wide range of flexible input/output capabilities. They can be used in a wide choice of operating modes and can be configured into real time systems with a minimum of special hardware and programming.

SDS92

SDS910

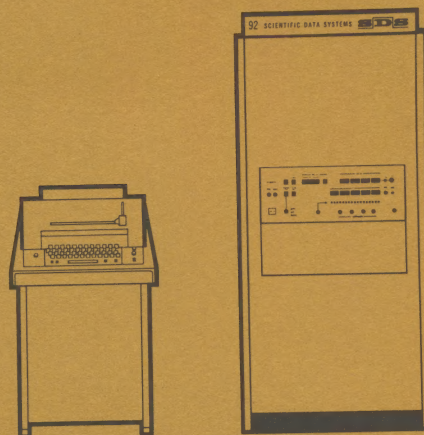
\$29,000 with 2048 words of memory, control console, buffered I/O channel and Model 35 Teletype Keyboard/Printer.

The first commercial computer using monolithic integrated circuits. Basic core memory of 2048 words, expandable to 32,768 words, all directly addressable. Memory "scratch pad" for immediate access to operands, addresses, and temporary storage. Hardware Index Register; indexing requires no additional time. One standard and any number of optional buffered I/O channels with rates to 572,000 words per second. Optional Memory Interlace Control permits core memory I/O without program intervention. Up to 256 levels of priority interrupt. . . . Memory cycle time: 1.75 μ sec. Execution times, including all accesses and indexing:

Fixed Point

(12 bits plus a parity bit)

Add.....	3.5 μ sec
Multiply.....	8.75 μ sec (optional)
Divide.....	22.75 μ sec (optional)



\$45,000 with 2048 words of memory, control console, buffered I/O channel, and Model 35 Teletype Keyboard/Printer with Paper Tape Reader and Punch. Basic core memory of 2048 words, expandable to 16,384 words, all directly addressable. One standard and one optional buffered I/O channel with rates to 62,500 words per second. Up to 1024 levels of priority interrupt. . . . Memory cycle time: 8.0 μ sec. Execution times, including all accesses and indexing:

Fixed Point

(24 bits plus a parity bit)

Add.....	16.0 μ sec
Multiply.....	248.0 μ sec

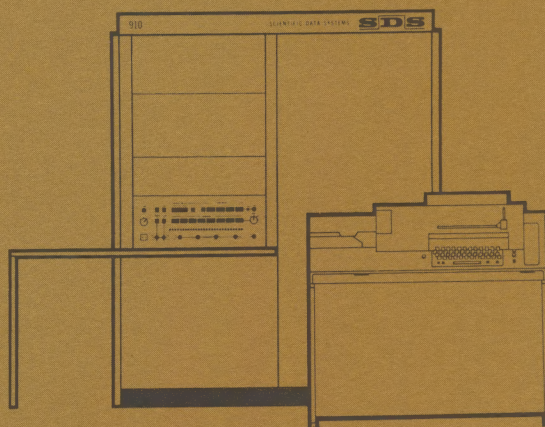
Floating Point

(24-bit frac., 9-bit exp.)

Add.....	432.0 μ sec
Multiply.....	464.0 μ sec

(39-bit frac., 9-bit exp.)

Add.....	896.0 μ sec
Multiply.....	1696.0 μ sec





SDS920

SDS925

\$65,000 with 4096 words of memory, control console, buffered I/O channel, and Model 35 Teletype Keyboard/Printer with Paper Tape Reader and Punch. Basic core memory of 4096 words, expandable to 16,384 words, all directly addressable. One standard and one optional buffered I/O channel with rates to 62,500 words per second. Up to 1024 levels of priority interrupt. . . . Memory cycle time: 8.0 μ sec. Execution times, including all accesses and indexing:

Fixed Point

(24 bits plus a parity bit)

Add.....	16.0 μ sec
Multiply.....	32.0 μ sec

Floating Point

(24-bit frac., 9-bit exp.)

Add.....	352.0 μ sec
Multiply.....	248.0 μ sec

(39-bit frac., 9-bit exp.)

Add.....	384.0 μ sec
Multiply.....	656.0 μ sec



\$82,500 with 4096 words of memory, control console, Time-Multiplexed Communication Channel, and Model 35 Teletype Printer with Paper Tape Reader Punch. Basic core memory of 4096 words, expandable to 16,384 words, all directly addressable. One standard and any number of optional buffered I/O channels with rates to 572,000 words per second. Up to 1024 levels of priority interrupt. . . . Memory cycle time: 1.75 μ sec. Execution times, including all accesses and indexing:

Fixed Point

(24 bits plus a parity bit)

Add.....	3.5 μ sec
Multiply.....	54.25 μ sec

Floating Point

(24-bit frac., 9-bit exp.)

Add.....	95.5 μ sec
Multiply.....	101.5 μ sec

(39-bit frac., 9-bit exp.)

Add.....	196.0 μ sec
Multiply.....	371.0 μ sec



SDS930

\$96,500 with 4096 words of memory, control console, Time-Multiplexed Communication Channel, and Model 35 Teletype Keyboard/Printer with Paper Tape Reader and Punch. Basic core memory of 4096 words, expandable to 32,768 words, all directly addressable. One standard and any number of optional buffered input/output channels with rates to 572,000 words per second. Input/output simultaneous with computation. Up to 1024 levels of priority interrupt. . . Memory cycle time: 1.75 μ sec. Execution times, including all accesses and indexing:

Fixed Point

(24 bits plus a parity bit)

Add.....	3.5 μ sec
Multiply.....	7.0 μ sec

Floating Point

(24-bit frac., 9-bit exp.)

Add.....	74.0 μ sec
Multiply.....	54.0 μ sec

(39-bit frac., 9-bit exp.)

Add.....	83.0 μ sec
Multiply.....	138.0 μ sec

SDS9300

\$150,000 with 4096 words of memory, control console, and Time-Multiplexed Communication Channel. Basic core memory of 4096 words, expandable to 32,768 words, all directly addressable. One standard and any number of optional buffered input/output channels with rates to 572,000 words per second. Input/output simultaneous with computation. Up to 1024 levels of priority interrupt. . . Memory cycle time: 1.75 μ sec. Execution times, including all accesses and indexing:

Fixed Point

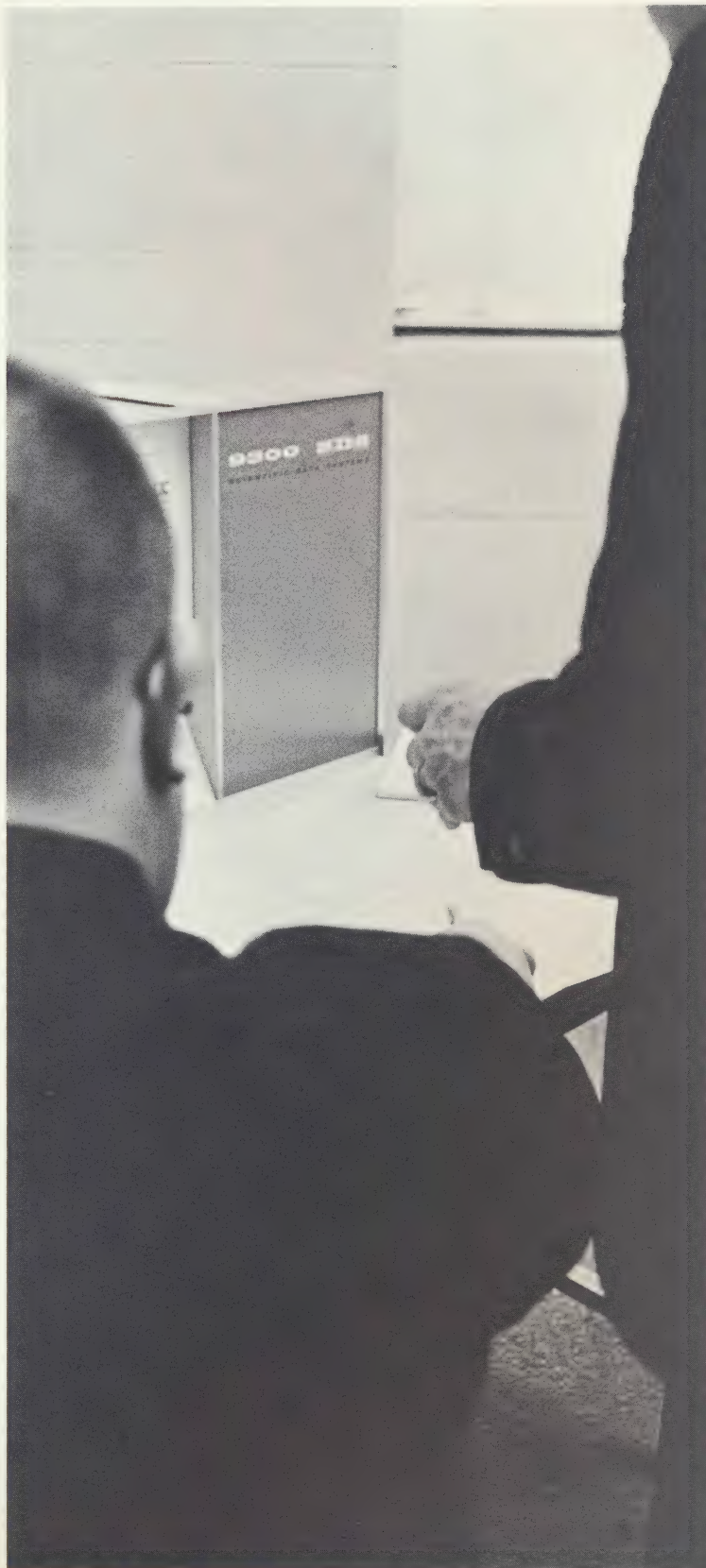
(24 bits plus a parity bit)

Add.....	1.75 μ sec
Double Precision Add.....	3.5 μ sec
Multiply.....	7.0 μ sec
Shift (24 positions).....	5.25 μ sec

Floating Point (with optional hardware)

(39-bit frac., 9-bit exp.)

Add.....	14.0 μ sec
Multiply.....	12.25 μ sec



PROGRAMMING SYSTEMS

Recognizing that computer users are concerned not only with hardware costs but also with operating economies, SDS has designed and developed its programming systems with the principal objectives of maximizing productivity and increasing efficiency. This approach results in significantly reduced costs for SDS computer users.

The expanding library of SDS programming systems provides the following advantages compatible with a user's specific requirements:

- Simple to learn and use
- Reduced programmer coding
- Ease of debugging
- Minimum operator intervention
- Efficient input/output and priority interrupt
- Uninterrupted processing of jobs
- Fast compilation and execution
- Increased throughput
- Program efficiency expandable with hardware

MONITOR and MONARCH □ The MONITOR program for the SDS 9300 and the MONARCH program for the SDS 910, 920, 925, and 930 provide total operational and supervisory control over the computer itself and a programming package of high capability. These programs control input and output, external and internal interrupts, operator communication, and program execution, permitting efficient patch processing with minimum operator intervention. This reduces throughput time and increases operational reliability.

META-SYMBOL □ META-SYMBOL is a high-level symbolic assembly language and processor compatible with all SDS computer systems. The assembly language is easy to learn and use and includes general expressions of one or more items combined by arithmetic and/or Boolean operators. Items can be single elements or lists. META-SYMBOL also has Function and Procedure capability, letting the programmer specify and use

in-line, nonmachine operations in symbolic programs without the time penalty imposed by a remote, closed subroutine.

SDS Business Language □ The SDS Business Language is a procedure-built language extension of META-SYMBOL that makes SDS binary word-oriented computers appear like decimal character-oriented computers to the business programmer. The language resembles Autocoder-type assemblers and frees the business programmer from such tasks as mask selection, loading, extracting, merging, and extensive shift operations.

SYMBOL □ This two-pass assembly program provides for input of symbolic programs from typewriter, paper tape, cards, or magnetic tape. Besides translating standard 900 Series instruction mnemonics and symbolic expressions, SYMBOL recognizes a variety of pseudo-operations that aid the user in coding and debugging his programs. SYMBOL also can assemble machine-language FORTRAN subroutines.

A one-pass SYMBOL assembler is available with the SDS 92 with 4096-word memory, paper tape or card I/O, and typewriter.

FORTRAN II and IV □ SDS FORTRAN II provides the user with a meaningful computer language, easily learned in simple form, but with the sophistication required to solve complex scientific problems. Although it features multilevel n-dimensional subscripting, mixed mode expressions, and "backward" DO-loops, SDS FORTRAN II occupies only 2500 memory locations. It allows over 300 variables, labels, etc., and compiles up to 500 statements per minute. SDS FORTRAN is a superset of most FORTRAN languages, even those associated with large-scale computing systems.

Real-Time FORTRAN II, an extension of standard SDS FORTRAN II, takes full advantage of the flexible I/O structure, especially priority interrupts, of SDS computers. Although designed for real-time applications, the compiler contains features desirable to the general user.

SDS FORTRAN IV, for the SDS 9300, conforms to and accepts the language of the standard FORTRAN IV version as defined and maintained by the American Standards Association. It has been extended, however,



to provide more complete capabilities and fewer restrictions.

A real-time version of SDS FORTRAN IV provides the speed and efficient communication with external devices required by SDS 9300 systems for operation in real-time environments.

ALGOL □ SDS ALGOL retains all the generality of ALGOL 60, the international algorithmic language, and represents the most comprehensive, least-restricted implementation of that language. An input/output facility similar to that of FORTRAN is incorporated into the language.

ALGOL systems include a compiler, loader/executor, and a library consisting of common input/output and mathematical function subroutines.

AID □ AID, the utility and debugging package consists of a group of commonly used routines controlled by an on-line, supervisory program through which the user requests assistance. AID contains minimal format restrictions and helps the programmer perform direct, on-line program checkout.

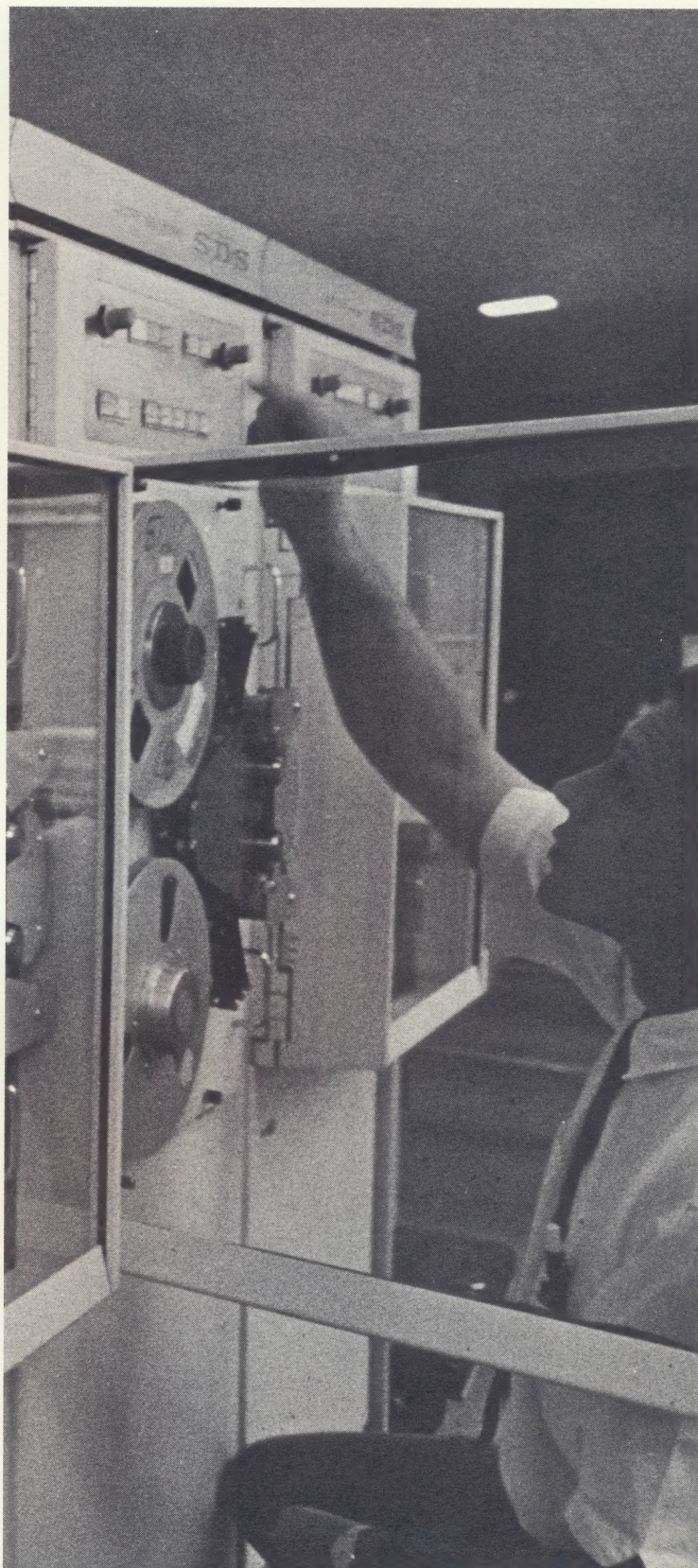
SDS Library □ The SDS Library contains over 300 programs covering such areas as special assemblers and compilers for large configurations; utility, load, and input/output media conversion; dump, debug, and trace programs; arithmetical and conversion programs for fixed- and floating-point arithmetic; mathematical routines; and a hybrid programming library.

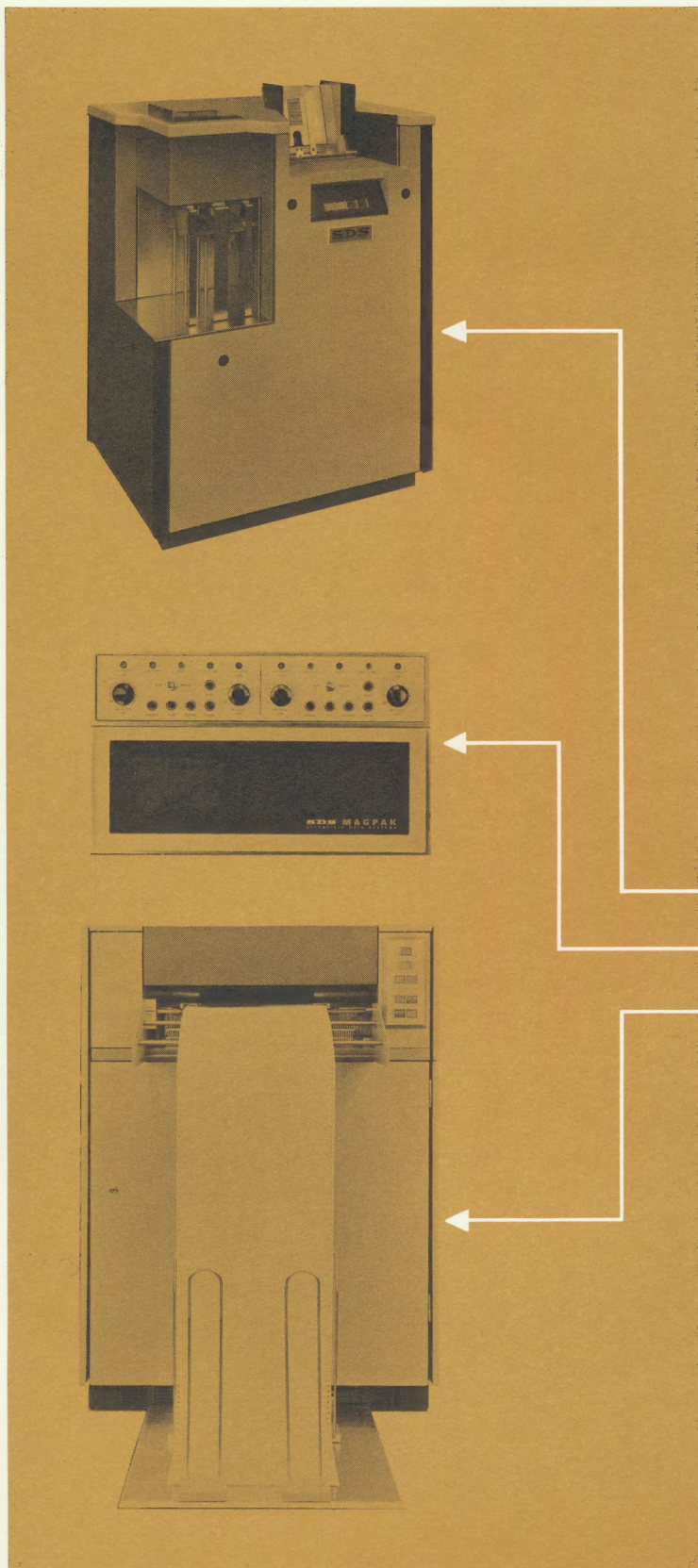
The library also includes programs for specific applications, such as SORT/MERGE and CPM scheduling.

SDS PERIPHERAL EQUIPMENT

The complete line of field-proven SDS peripheral equipment is available for use with all SDS computers. Each unit is controlled by its own coupling electronics and requires no interfacing.

This equipment includes SDS MAGPAK, a low-cost magnetic tape system that consists of two independent tape drives, each of which controls a tape cartridge





holding approximately 600 feet of Mylar base tape. With two independent information tracks on each tape, a single MAGPAK provides a total of four data channels. Each channel has a capacity of approximately 1.5 million six-bit characters. Transfer rate is 1500 characters/second. MAGPAK provides all of the operational functions of standard SDS high-performance IBM-compatible tape units and uses the same instruction list.

As a result, programs written for MAGPAK and those written for standard magnetic tape units are identical. Other available equipment includes:

- Paper tape I/O equipment
- High- and low-speed card readers
- High- and low-speed card punches
- High-, medium-, and low-speed line punches
- High-, medium-, and low-speed magnetic tape units
- Magnetic drums
- Magnetic disc files
- Digital plotters
- Display scopes, light pens, and character and vector generators

CARD READER □ 800 cards/min

MAGPAK Transport Pair □ 1.5 million characters, 1500 characters/sec

LINE PRINTER □ 800 lines/min, 132 characters/line, 52 printable characters

SDS DATA COMMUNICATIONS EQUIPMENT

SDS Data Communications Equipment provides all SDS computers with multichannel communication through common carrier or privately owned transmission facilities for applications such as time-sharing systems, inquiry-answer systems, message-switching systems, and remote data processing systems.



SDS offers two methods of terminating low-speed (less than 150 words per minute) data transmission lines:

- 1 Fully buffered, character assembly/disassembly using SDS Automatic Data Communication Equipment (DCE) that makes extensive use of integrated circuitry.
- 2 A line-sampling technique using SDS Line Sampling Chassis (LSC) and bit-by-bit transmission.

With the first method, the DCE synchronizes signals, allows for distortion, assembles and stores characters, distributes bits, and generates timing pulses. With the line-sampling technique, the computer performs these functions under program control.

Selecting the appropriate line-termination method depends on several factors such as the number of transmission lines to be terminated, the number of types and grades of communication service, and the amount of data processing that the computer must perform in addition to controlling communications. The cost of line-terminating hardware is usually two to three times less with Line-Sampling Chassis than with Automatic Data Communications Equipment, but the computer time required for communications control is much higher. For instance, a typical 30-line system might require 5 percent of the available computer time using Automatic Data Communications Equipment and 35 to 40 percent using Line-Sampling Chassis.

Computer-based data communications systems using these line-termination techniques can be divided into three broad categories:

- 1 Small systems that require terminating only a few transmission lines and a limited amount of data processing. In this case, the line-sampling method is used with a small general-purpose computer such as the SDS 92 or 925, which controls the communications network and performs all data-processing functions.

- 2 Larger systems that require terminating many transmission lines and a large amount of data processing. In this case, SDS Automatic Data Communications Equipment is used with a small- or medium-sized general-purpose computer to control the communications network and perform all data processing functions.

- 3 Very large and complex systems in which a small SDS computer with Line-Sampling Chassis controls the communications network and a second SDS computer performs all data processing functions. In this case, the smaller computer and LSCs perform the functions of the DCE in the second category.

For high-speed communication between remotely located computers and long distance transmission of large volumes of data, SDS provides a Data Set Coupler for use with Bell System Data Sets. This permits transmitting digital data over voice-grade or other broadband communication facilities such as regular or private telephone lines or WATS (Wide Area Telephone Service). Data can be transmitted in a variety of formats from one to 24 bits at rates up to 40,800 bits per second. The coupler operates synchronously or asynchronously and permits automatic dialing.

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